341-772
200

54/.2-33
d

FEM 1.209: 340237
2374

# FLOOD INSURANCE STUDY

2/20/81
ocm

## CITY OF LAMBERTVILLE, NEW JERSEY
HUNTERDON COUNTY

OCTOBER 1, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 340237

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| 1.0 | INTRODUCTION | 1 |
| | 1.1 Purpose of Study | 1 |
| | 1.2 Authority and Acknowledgements | 1 |
| | 1.3 Coordination | 2 |
| 2.0 | AREA STUDIED | 2 |
| | 2.1 Scope of Study | 2 |
| | 2.2 Community Description | 4 |
| | 2.3 Principal Flood Problems | 6 |
| | 2.4 Flood Protection Measures | 6 |
| 3.0 | ENGINEERING METHODS | 10 |
| | 3.1 Hydrologic Analyses | 10 |
| | 3.2 Hydraulic Analyses | 11 |
| 4.0 | FLOOD PLAIN MANAGEMENT APPLICATIONS | 14 |
| | 4.1 Flood Boundaries | 14 |
| | 4.2 Floodways | 14 |
| 5.0 | INSURANCE APPLICATION | 17 |
| | 5.1 Reach Determinations | 18 |
| | 5.2 Flood Hazard Factors | 19 |
| | 5.3 Flood Insurance Zones | 19 |
| | 5.4 Flood Insurance Rate Map Description | 21 |

TABLE OF CONTENTS - continued


| | Page |
|---|---|
| 6.0 OTHER STUDIES | 21 |
| 7.0 LOCATION OF DATA | 22 |
| 8.0 BIBLIOGRAPHY AND REFERENCES | 22 |


FIGURES


| | |
|---|---|
| Figure 1 - Vicinity Map | 3 |
| Figure 2 - Flood Damage, Lambertville, New Jersey | 7 |
| Figure 3 - Flood Damage, Lambertville, New Jersey | 7 |
| Figure 4 - Flood Damage, Lambertville, New Jersey | 8 |
| Figure 5 - Flood Damage, Lambertville, New Jersey | 8 |
| Figure 6 - Potential Flood Elevations, Lambertville, New Jersey | 13 |
| Figure 7 - Potential Flood Elevations, Lambertville, New Jersey | 13 |
| Figure 8 - Floodway Schematic | 18 |


TABLES


| | |
|---|---|
| Table 1 - Regulatory Lakes and Reservoirs Upstream of the City of Lambertville | 9 |
| Table 2 - Summary of Discharges | 11 |
| Table 3 - Floodway Data | 15 |
| Table 4 - Flood Insurance Zone Data | 20 |

TABLE OF CONTENTS - continued

EXHIBITS


| | | |
|---|---|---|
| Exhibit 1 | Flood Profiles | |
| | Delaware River | Panel 01P |
| | Swan Creek | Panels 02P-03P |
| | Swan Creek Tributary | Panel 04P |
| | Alexauken Creek | Panel 05P |
| Exhibit 2 | Flood Boundary and Floodway Map | |


PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF LAMBERTVILLE, NEW JERSEY

# 1.0 INTRODUCTION

## 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Lambertville, Hunterdon County, New Jersey, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Lambertville to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 24 CFR, 1910.1(d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

## 1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the State of New Jersey, Department of Environmental Protection, Division of Water Resources, for the Federal Insurance Administration, under Contract No. H-3959. This work was completed in May 1978. The hydrologic and hydraulic analyses for this study were conducted by Michael Baker, Jr., Inc. under subcontract to the State of New Jersey, Department of Environmental Protection. Certain hydrologic data for the Delaware River performed by the Delaware River Basin Commission were adopted for use in this study.

### 1.3 Coordination

The identification of streams for detailed and approximate study was made by representatives of the City of Lambertville, the FIA, and the New Jersey Department of Environmental Protection (DEP) at a meeting held on May 26, 1976.

A Consultation and Coordination Officer's (CCO) meeting was held on March 23, 1977, with representatives of the City of Lambertville, the DEP, and Michael Baker, Jr., Inc., to discuss areas to be studied and to request information on past flooding in the community.

A legal notice announcing the beginning of the study and stating its objectives was placed in the local newspaper once a week for three consecutive weeks.

Agencies and individuals contacted for coordination of mapping, hydrologic, and hydraulic information during the course of this study were the Delaware River Basin Commission (DRBC), the DEP, the Philadelphia District of the U. S. Army Corps of Engineers (COE), the Trenton and Harrisburg offices of the U. S. Geological Survey (USGS), the National Weather Service, the Soil Conservation Service (SCS), City of Lambertville representatives, and local citizens.

City officials were contacted for information as needed throughout the course of the study and were kept informed of progress. The final CCO meeting was held on April 30, 1980, at which time the results of this study were reviewed by representatives of the City of Lambertville, the FIA, the DEP, Michael Baker, Jr., Inc., and interested citizens.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Lambertville, Hunterdon County, New Jersey. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied in detail: the Delaware River for its entire length along the city's western boundary, a distance of 1.5 miles; Swan Creek from its mouth on the Delaware River for its entire

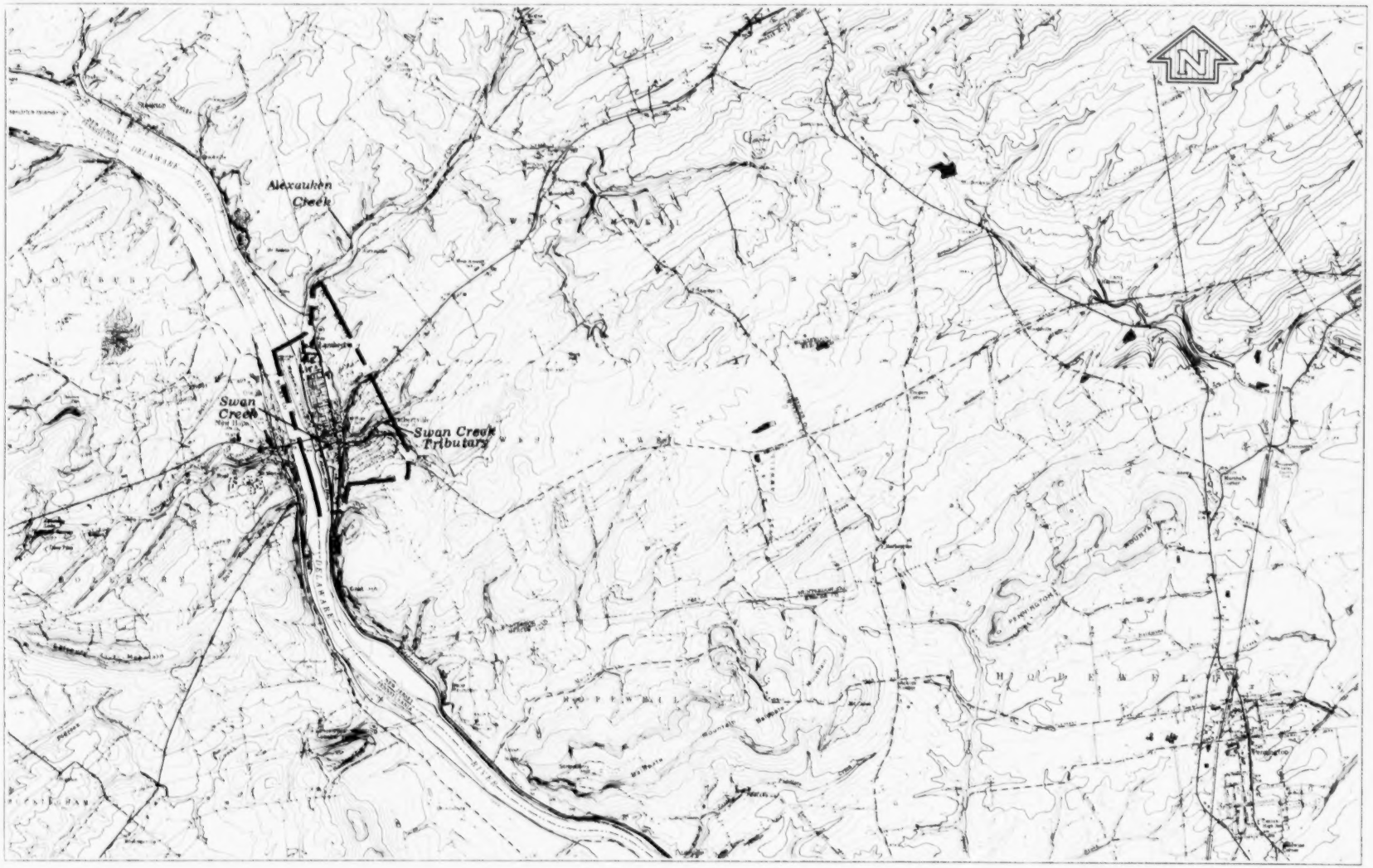



FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

# CITY OF LAMBERTVILLE, NJ
(HUNTERDON CO.)

APPROXIMATE SCALE
6700 0 6700 13400 20100 FEET

## VICINITY MAP

length within the city to the eastern corporate limits, a distance of 0.8 mile; Swan Creek Tributary from its mouth on Swan Creek for its entire length within the city to the eastern corporate limits, a distance of 0.2 mile; and Alexauken Creek from its mouth on the Delaware River for its entire length along the northern boundary of the city, a distance of 0.8 mile. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through May 1983.

Approximate methods were used to study an unnamed tributary to the Delaware River which flows through the southernmost part of the city, and an unnamed stream which flows southwest along York Street and then north to North Main Street. However, negligible flood hazards were found to exist on these streams, and no flood boundaries were mapped for them. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FIA, and the City of Lambertville.

## 2.2 Community Description

The City of Lambertville is located on the western border of central New Jersey in southwestern Hunterdon County, approximately 14 miles northwest of Trenton. It is bounded on the west by the Delaware River and the Borough of New Hope and the Township of Solebury in Pennsylvania, by the Township of Delaware, New Jersey on the north, and by the Township of West Amwell on the east and south.

Lambertville, which was incorporated on March 1, 1849, became a city in 1872. The 1970 population of 4,359 represents a slight increase over the 1960 population (Reference 1). The city has a total land area of 1.3 square miles.

The climate of the Lambertville area is continental and influenced only slightly by the ocean. This area has an average daily maximum temperature of 64 degrees Fahrenheit (°F) and a daily minimum of 42°F, with extremes ranging from 99°F to -7°F over the year. The average annual precipitation in Lambertville is well distributed over the year and totals about 45 inches.

Lambertville lies in the Piedmont Plateau region, which is part of the Appalachian Province. The Piedmont is characterized by nearly level lowlands with occasional ridges and low hills and is underlain by sedimentary rocks comprised mainly of argillite, sandstone, and shale (Reference 2). Elevations range from 40 feet at the Delaware River to 340 feet in the extreme southeastern corner of the city. The Delaware River, which has a total drainage area of 12,265 square miles, is the major waterway feeding the Delaware Bay (Reference 3). With its headwaters in the Catskill Mountains in southeastern New York State, the Delaware River flows southerly along the western border of Lambertville. Its watershed upstream of Lambertville consists primarily of open, agricultural, and wooded land away from the main river channel and areas of highly urbanized development along the river banks. The largest of these is the Allentown-Bethlehem-Easton area along the Lehigh and Delaware Rivers in Pennsylvania. Other smaller urban areas immediately upstream of Lambertville in New Jersey include Stockton, Milford, Frenchtown, and Phillipsburg.

Swan Creek, flowing northwest as it enters the city, is joined by Swan Creek Tributary about 1,000 feet inside the city limits and then flows west into the Delaware River. Swan Creek and its tributary drain the southern part of the city. The channel slope of Swan Creek between its mouth and the confluence with its tributary averages about 85 feet per mile. Stream channel elevations from the confluence of Swan Creek and Swan Creek Tributary to the city's corporate limits increase 35 feet for Swan Creek over a distance of about 1,300 feet and 20 feet for the tributary over a distance of about 1,200 feet. Both portions of these streams have steep channel slopes with high velocities. The Swan Creek watershed is highly developed near the creek in Lambertville, with scattered residential development, open spaces, agricultural lands, and woodlands predominant in the upper watershed.

Alexauken Creek, which flows in a westerly direction along the northern boundary of Lambertville, has its headwaters in the Township of East Amwell. Channel elevations on Alexauken Creek along the city boundary increase 15 feet over a distance of about 4,000 feet. The watershed consists primarily of open and agricultural land and woodland, with very little residential development.

Land use in the City of Lambertville is primarily for residential, commercial, and industrial purposes. Around 1872, development consisted of a variety of businesses such as shops, mills, professional services, foundries, restaurants, and hotels. Today, Lambertville has the same diversity of commerce. Some of the industries

in Lambertville produce apparel, electrical machinery and supplies, fabricated metal products, food products, furniture, luggage, and publishing services (Reference 4).

## 2.3 Principal Flood Problems

Flooding has been a continual problem along the Delaware River since settlement of the area in the early part of the 17th century. The Delaware River Basin is located in an area of major storm paths. Although the most severe floods in the past generally resulted from excessive rainfall alone, flooding on the Delaware River in early spring can be even more severe because of moving ice and snowmelt.

Floods of major significance on the Delaware River occurred in October 1903, August 1955, and May 1972. The flood of August 1955 was the most devastating event experienced on the Delaware River in recent times.

This flood, which had a recurrence interval of approximately 150 years, caused extensive damage in Lambertville. The Lambertville-New Hope bridge was closed for four weeks after the flood, because of structural weakness and storm debris (Figures 2 and 3). This span between Lambertville and New Hope had been destroyed in the 1903 flood, but was rebuilt. Businesses and factories also sustained major damage. Damage in Lambertville from North Main Street to the river totalled over half a million dollars (Figure 4). A few of the businesses which suffered major damage were Belmont Forwarders, Inc., the Lambertville Water Company, the Mercer Paper Tube Company, and Holcombe's Nursery (Reference 5). Many small businesses and residences were flooded (Figures 4 and 5).

The most recent high water on the Delaware River occurred in June 1973. The flood of June 1972, resulting from the rainfall of Tropical Storm Agnes, although producing severe flooding on the Schuylkill River and many other streams in Pennsylvania, did not cause major flooding on the Delaware River (References 6 and 7).

Major flooding on Alexauken Creek and Swan Creek, in Lambertville, usually results from backwater from the Delaware River causing overflow in their lower reaches. They also occasionally experience flash flooding, which causes high channel velocities and resultant scour and erosion.

## 2.4 Flood Protection Measures

No flood protection measures to reduce potential flood damages exist in Lambertville; however, water-supply, power, and flood-control

Figure 2 - Looking toward Lambertville at the upstream side of the Lambertville-New Hope bridge, flood of August 1955.

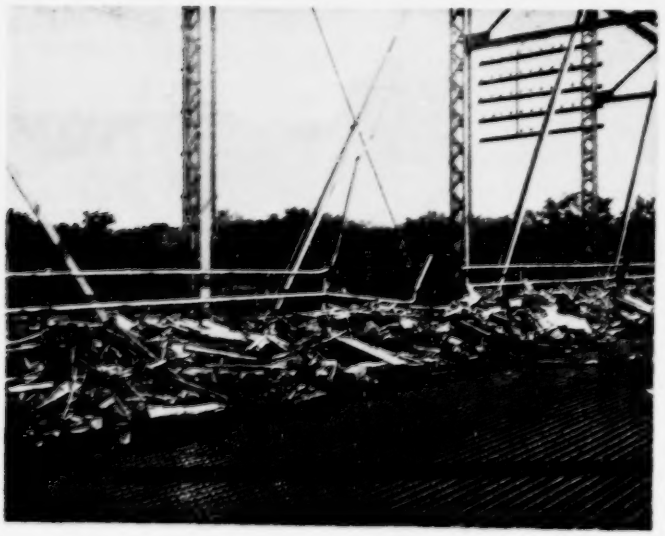


Figure 3 - Debris on Lambertville-New Hope bridge after flood of August 1955, Lambertville, New Jersey.

Figure 4 - Intersection of Main Street and Ferry Street looking along Ferry Street, Flood of August 1955, Lambertville, New Jersey.

Figure 5 - Flooding along North Union Street, August 1955, Lambertville, New Jersey.

reservoirs outside the city have reduced the probability of damaging floods. Table 1 lists the major regulatory reservoirs and lakes, the drainage areas they control, and the date storage began for the Delaware River Basin upstream of Lambertville (References 6 and 8).

TABLE 1 - REGULATORY LAKES AND RESERVOIRS UPSTREAM OF THE CITY OF LAMBERTVILLE

| Name | Stream | Drainage Area | Date Storage Began |
|---|---|---|---|
| Lake Wallenpaupack | Wallenpaupack Creek | 228 | November 1925 |
| Prompton Reservoir | West Branch Lackawaxen River | 59.6 | July 1960 |
| General Edgar Jadwin Reservoir | Dyberry Creek | 64.5 | October 1959 |
| Francis E. Walter Reservoir | Lehigh River | 289 | February 1961 |
| Beltzville Lake | Pohopoco Creek | 96.3 | February 1971 |
| Pepacton Reservoir | East Branch Delaware River | 371 | September 1954 |
| Swinging Bridge Reservoir | Mongaup River | 118 | January 1930 |
| Neversink Reservoir | Neversink River | 91.8 | January 1953 |
| Cannonsville Reservoir | West Branch Delaware River | 454 | September 1963 |
| Penn Forest Reservoir | Wild Creek | 16.5 | October 1953 |
| Wild Creek Reservoir | Wild Creek | 22.2 | January 1941 |
| Lake Hopatcong | Musconetcong River | 25.6 | 1828 |
| Toronto Reservoir | Black Lake Creek | 23.2 | January 1926 |
| Cliff Lake | Black Lake Creek | 6.46 | January 1939 |

Completion dates for two proposed reservoirs in the Lehigh River Basin, Aquashicola and Trexler, have not been set; therefore, the effects of these reservoirs were not considered in the course of this study.

## 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

### 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Flood-frequency analysis procedures developed by the Water Resources Council (Reference 9) were employed for the Delaware River in the Flood Insurance Study for the Pennsylvania Community of New Hope and were adopted for use in this study (Reference 10). A log-Pearson Type III distribution of annual peak flows at the stream gage at Trenton, New Jersey, was used to determine the 10-, 50-, 100-, and 500-year peak discharges on the Delaware River. Seventy years of records at the Trenton gage were used in this analysis. A modification of frequency distributions was made to allow for the effects of reservoir regulation.

Flood-frequency values for Swan Creek, Swan Creek Tributary, and Alexauken Creek were determined by use of a regional regression analysis which considers drainage area, channel slope, surface storage and the extent of impervious areas in determining the peak discharges for the 10-, 50-, 100-, and 500-year floods (Reference 11).

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 2, "Summary of Discharges."

TABLE 2 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| DELAWARE RIVER | | | | | |
| At the Trenton gage | 6,780 | 170,000 | 250,000 | 288,000 | 387,000 |
| SWAN CREEK | | | | | |
| At the mouth | 3.43 | 480 | 810 | 1,000 | 1,560 |
| Above confluence with Swan Creek Tributary | 1.90 | 250 | 430 | 540 | 880 |
| SWAN CREEK TRIBUTARY | | | | | |
| At the mouth | 1.31 | 300 | 520 | 660 | 1,080 |
| ALEXAUKEN CREEK | | | | | |
| At the mouth | 14.78 | 1,830 | 2,980 | 3,690 | 5,800 |

Potential 100- and 500-year flood elevations at the Lambertville-New Hope bridge and the Hibernia Fire Company on South Main Street are shown in Figures 6 and 7, respectively.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Cross sections for the backwater analysis of the Delaware River were field-surveyed by the COE with additional information taken from topographic maps of the area (References 12 and 13). All cross sections for Swan Creek, Swan Creek Tributary, and Alexauken

Creek were obtained by photogrammetric compilation and were located at close intervals above and below bridges and culverts in order to compute significant backwater effects. All bridge data for these streams were obtained by field surveys.

Roughness coefficients (Manning's "n") for these computations were assigned on the basis of field inspection of the flood plain areas, by comparison with high-water marks where available, and, for the Delaware River, from previous studies by the COE. Following is a list of the range of "n" values for the channel and overbank areas of each stream.

| | Channel "n" | Overbank "n" |
|---|---|---|
| Delaware River | 0.029 | 0.10 - 0.12 |
| Swan Creek | 0.06 - 0.07 | 0.10 - 0.15 |
| Swan Creek Tributary | 0.07 | 0.15 |
| Alexauken Creek | 0.045 | 0.11 |

Starting water-surface elevations on the Delaware River were obtained from the gage at Trenton. For Swan Creek, Swan Creek Tributary, and Alexauken Creek, starting water-surface elevations were estimated by the slope/area method, as outlined in the COE HEC-2 users manual (Reference 14). Water-surface elevations for floods of the selected recurrence intervals were computed through use of the HEC-2 step-backwater computer program (Reference 15).

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

Figure 6 - Potential 100-year and 500-year flood elevations at the Lambertville end of the Lambertville-New Hope bridge.

Figure 7 - Potential 500-year flood elevation at the Hibernia Fire Station on South Main Street, Lambertville, New Jersey.

## 4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

### 4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 12). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

### 4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus,

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Delaware River | | | | | | | | |
| A | 2,420[1] | 1,142/490[3] | 26,510 | 10.8 | 68.7 | 68.7 | 69.6 | 0.9 |
| B | 4,450[1] | 935/430[3] | 25,183 | 11.4 | 70.9 | 70.9 | 71.7 | 0.8 |
| C | 7,090[1] | 945/475[3] | 25,984 | 11.1 | 72.8 | 72.8 | 73.4 | 0.6 |
| Swan Creek | | | | | | | | |
| A | 168[2] | 50 | 165 | 6.0 | 69.2 | 53.1[4] | 53.1 | 0.0 |
| B | 549[2] | 37 | 143 | 7.0 | 69.2 | 59.2[4] | 59.2 | 0.0 |
| C | 845[2] | 58 | 243 | 4.1 | 69.2 | 63.4[4] | 63.5 | 0.1 |
| D | 1,172[2] | 36 | 136 | 7.3 | 69.2 | 67.1[4] | 67.1 | 0.0 |
| E | 1,383[2] | 39 | 148 | 6.7 | 70.2 | 70.2 | 70.2 | 0.0 |
| F | 1,529[2] | 39 | 154 | 6.5 | 73.3 | 73.3 | 73.3 | 0.0 |
| G | 1,692[2] | 42 | 160 | 6.2 | 74.9 | 74.9 | 75.0 | 0.1 |
| H | 2,242[2] | 26 | 148 | 6.8 | 86.4 | 86.4 | 86.4 | 0.0 |
| I | 2,461[2] | 51 | 182 | 5.5 | 91.8 | 91.8 | 92.0 | 0.2 |
| J | 2,907[2] | 35 | 139 | 7.2 | 100.7 | 100.7 | 100.9 | 0.2 |
| K | 3,344[2] | 40 | 92 | 5.9 | 113.0 | 113.0 | 113.0 | 0.0 |
| L | 3,870[2] | 26 | 73 | 7.4 | 128.5 | 128.5 | 128.5 | 0.0 |
| M | 4,183[2] | 36 | 102 | 5.3 | 136.3 | 136.3 | 136.3 | 0.0 |

[1] Feet above corporate limits
[2] Feet above Feet above confluence with Delaware River
[3] Width/width within corporate limits
[4] Elevations computed without consideration of backwater effects from Delaware River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF LAMBERTVILLE, NJ**
**(HUNTERDON CO.)**

**FLOODWAY DATA**

**DELAWARE RIVER AND SWAN CREEK**

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Swan Creek Tributary | | | | | | | | |
| A | 309[1] | 26 | 70 | 9.4 | 111.1 | 111.1 | 111.1 | 0.0 |
| B | 959[1] | 28 | 99 | 6.7 | 124.3 | 124.3 | 124.3 | 0.0 |
| Alexauken Creek | | | | | | | | |
| A | 845[2] | 273/53[3] | 1,588 | 2.3 | 73.0 | 59.7[4] | 59.8 | 0.1 |
| B | 1,400[2] | 202/98[3] | 1,176 | 3.1 | 73.0 | 60.9[4] | 61.0 | 0.1 |
| C | 1,953[2] | 101/31[3] | 640 | 5.8 | 73.0 | 62.1[4] | 62.3 | 0.2 |
| D | 2,515[2] | 100/24[3] | 569 | 6.5 | 73.0 | 66.2[4] | 66.3 | 0.1 |
| E | 3,545[2] | 72/38[3] | 488 | 7.6 | 73.0 | 72.4[4] | 72.5 | 0.1 |

[1] Feet above confluence with Swan Creek
[2] Feet above confluence with Delaware River
[3] Width/width within corporate limits
[4] Elevations computed without consideration of backwater effects from Delaware River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF LAMBERTVILLE, NJ**
**(HUNTERDON CO.)**

**FLOODWAY DATA**

**SWAN CREEK TRIBUTARY AND ALEXAUKEN CREEK**

floodways having no more than a 0.2-foot surcharge have been delineated for Swan Creek, Swan Creek Tributary, and Alexauken Creek. However, since the Delaware River acts as the boundary between the States of New Jersey and Pennsylvania, the floodway for the Delaware River was determined based upon a surcharge of 1.0 foot. This is in accordance with FIA standards for floodways of streams dividing two states. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

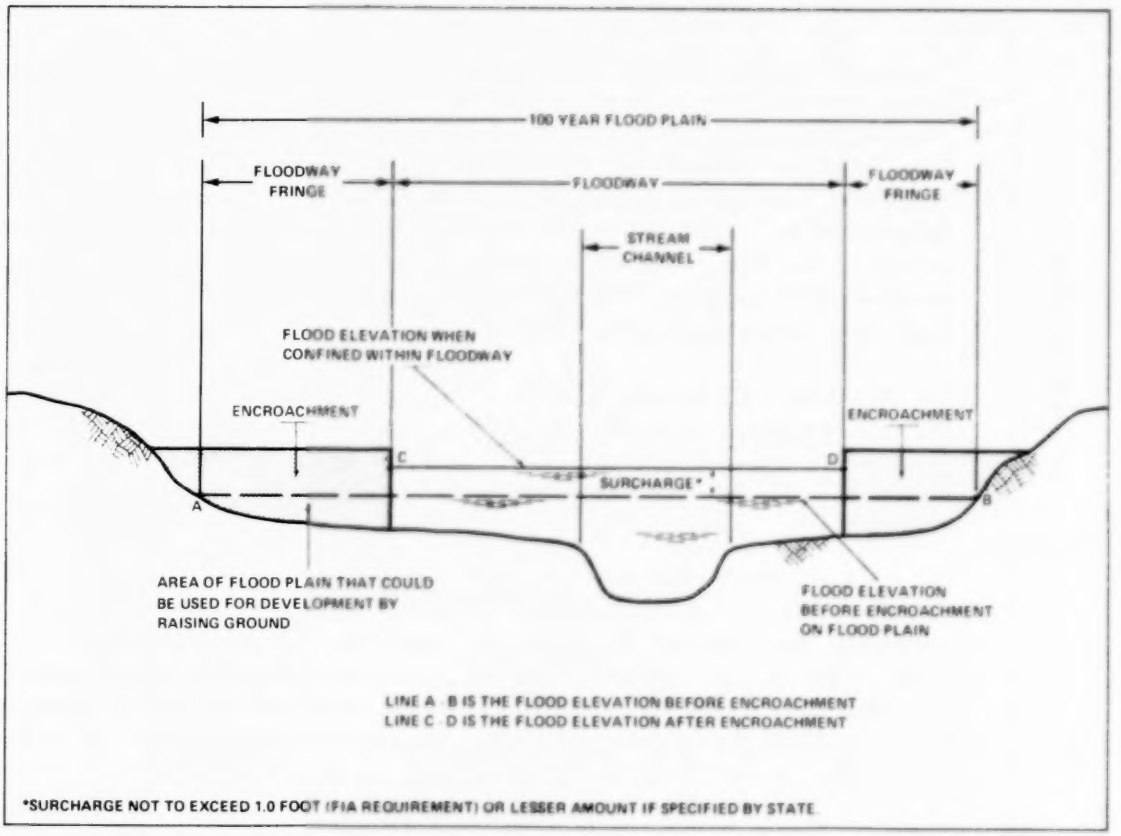
As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. Portions of the floodways computed for the Delaware River and Alexauken Creek lie outside the Lambertville corporate boundaries.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point on the Delaware River or more than 0.2 foot at any point on Swan Creek, Swan Creek Tributary, and Alexauken Creek. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 8.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "With Floodway" elevations presented in Table 3 for certain downstream cross sections of Swan Creek and Alexauken Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

## 5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

**FLOODWAY SCHEMATIC** Figure 8

insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the City of Lambertville.

## 5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

| Average Difference Between 10- and 100-Year Floods | Variation |
|---|---|
| Less than 2 feet | 0.5 foot |
| 2 to 7 feet | 1.0 foot |
| 7.1 to 12 feet | 2.0 feet |
| More than 12 feet | 3.0 feet |

The locations of the reaches determined for the flooding sources of the City of Lambertville are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 4).

## 5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

## 5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Lambertville was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

| | |
|---|---|
| Zones A3, A4, A16: | Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF. |
| Zone B: | Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided. |
| Zone C: | Areas of minimal flooding. |

| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FHF | ZONE | BASE FLOOD ELEVATION[3] (NGVD) |
|---|---|---|---|---|---|---|---|
| | | 10% (10 YR.) | 2% (50 YR.) | 0.2% (500 YR.) | | | |
| Delaware River Reach 1 | 01 | -8.1 | -2.6 | +6.0 | 080 | A16 | Varies |
| Swan Creek Reach 1 | 01 | -1.6 | -0.6 | +1.6 | 015 | A3 | Varies |
| Swan Creek Tributary Reach 1 | 01 | -1.8 | -0.6 | +1.2 | 020 | A4 | Varies |
| Alexauken Creek Reach 1 | 01 | -2.0 | -0.7 | +1.8 | 020 | A4 | Varies |

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF LAMBERTVILLE, NJ**
**(HUNTERDON CO.)**

## FLOOD INSURANCE ZONE DATA

**DELAWARE RIVER, SWAN CREEK, SWAN CREEK TRIBUTARY AND ALEXAUKEN CREEK**

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the city.

### 5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Lambertville is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

## 6.0 OTHER STUDIES

A Flood Plain Information Report on the Delaware River, prepared by the COE in 1967, was a planning document to evaluate the effects of the Tocks Island Dam Project (Reference 16). It did not assign frequencies to the discharges used; therefore, numerical comparisons with this report were not made.

A flood plain delineation report was published by the DRBC in 1973 (Reference 17). That report was also a planning document with which numerical comparisons could not be made.

Flood Insurance Studies have been prepared for the Borough of New Hope and the Township of Solebury, both located across the Delaware River from Lambertville in Bucks County, Pennsylvania (References 10 and 18). The Baltimore District office of the COE has indicated that the Delaware River discharges used in the original Solebury study were based on an older, unpublished regional study by the Baltimore District. This earlier study did not consider hurricane effects or recent floods. The discharges used in the New Hope study were based on more recent information. The analyses used in the New Hope study were adopted for use in the present study.

Flood Insurance Studies are also underway for the Township of West Amwell and the Township of Delaware, in Hunterdon County (References 19 and 20). These studies agree exactly with the results of this report.

No other studies affecting the City of Lambertville were found at the date of this study.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

## 7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region II Office, 90 Church Street, Room 801, New York, New York 10007.

## 8.0 BIBLIOGRAPHY AND REFERENCES


1. U. S. Department of Commerce, Bureau of the Census, 1970 Census of Population, Number of Inhabitants, New Jersey, Washington, D. C., U. S. Government Printing Office, 1971.

2. U. S. Department of Agriculture, Soil Conservation Service, Soil Survey, Hunterdon County, New Jersey, Washington, D. C., 1974.

3. U. S. Department of the Interior, Geological Survey, Flood Discharge Records Relating to Pennsylvania Streams, Harrisburg, Pennsylvania, 1960.

4. Hunterdon County Chamber of Commerce, Industrial Directory, Hunterdon County, New Jersey, 1978, Flemington, New Jersey.

5. The Great Flood Disaster of 1955, Picture Story of the Greatest Castastrophe in the History of Hunterdon and Bucks Counties, Flemington, New Jersey, 1955.

6. U. S. Department of the Interior, Geological Survey, Water Resources Data for Pennsylvania, Part I, Surface Water Records, Harrisburg, Pennsylvania, Published Annually 1961-1976.

7. U. S. Department of the Interior, Geological Survey, Water-Supply Paper 1672, Magnitude and Frequency of Floods in the United States, Part 1-B. North Atlantic Slope Basins, New York to York River by Richard H. Tice, Washington, D. C., 1968.

8. U. S. Army Corps of Engineers, Hydrologic Engineering Center, Regional Frequency Study, Upper Delaware and Hudson River Basins, New York District, Davis, California, 1974.

9. Water Resources Council, "A Uniform Technique for Determining Flood Flow Frequency," Bulletin 15, Washington, D. C., December 1967.

10. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Borough of New Hope, Bucks County, Pennsylvania, Washington, D. C., December 1977.

11. State of New Jersey, Department of Environmental Protection, Division of Water Resources, Special Report 38, Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization by Stephen J. Stanskowski, Trenton, New Jersey, 1974.

12. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Lambertville, New Jersey, 1973; Stockton, New Jersey, 1970.

13. Van Note/Harvey Engineers, Topographic Maps, Scale 1:24,000, Contour Interval 2 Feet: City of Lambertville, Hunterdon County, New Jersey, 1977.

14. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Users Manual, Davis, California, October 1973.

15. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

16. U. S. Army Corps of Engineers, Philadelphia District, Flood Plain Information Report, Delaware River, Bucks County, Pennsylvania, Philadelphia, Pennsylvania, July 1967.

17. Delaware River Basin Commission, Basin-Wide Program for Flood Plain Delineation, Trenton, New Jersey, June 1973.

18. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of Solebury, Bucks County, Pennsylvania, Washington, D. C., April 1977.

19. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of West Amwell, Hunterdon County, New Jersey (Unpublished).

20. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Delaware, Hunterdon County, New Jersey (Unpublished).

Beard, Leo R., Statistical Methods in Hydrology, Sacramento, California, U. S. Army Corps of Engineers, January 1962.

Chow, Ven Te, ed., Handbook of Applied Hydrology, New York, McGraw-Hill, 1964.

Chow, Ven Te, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

Gray, Donald M., Principles of Hydrology, Ottawa, Canada, National Research Council of Canada, 1970.

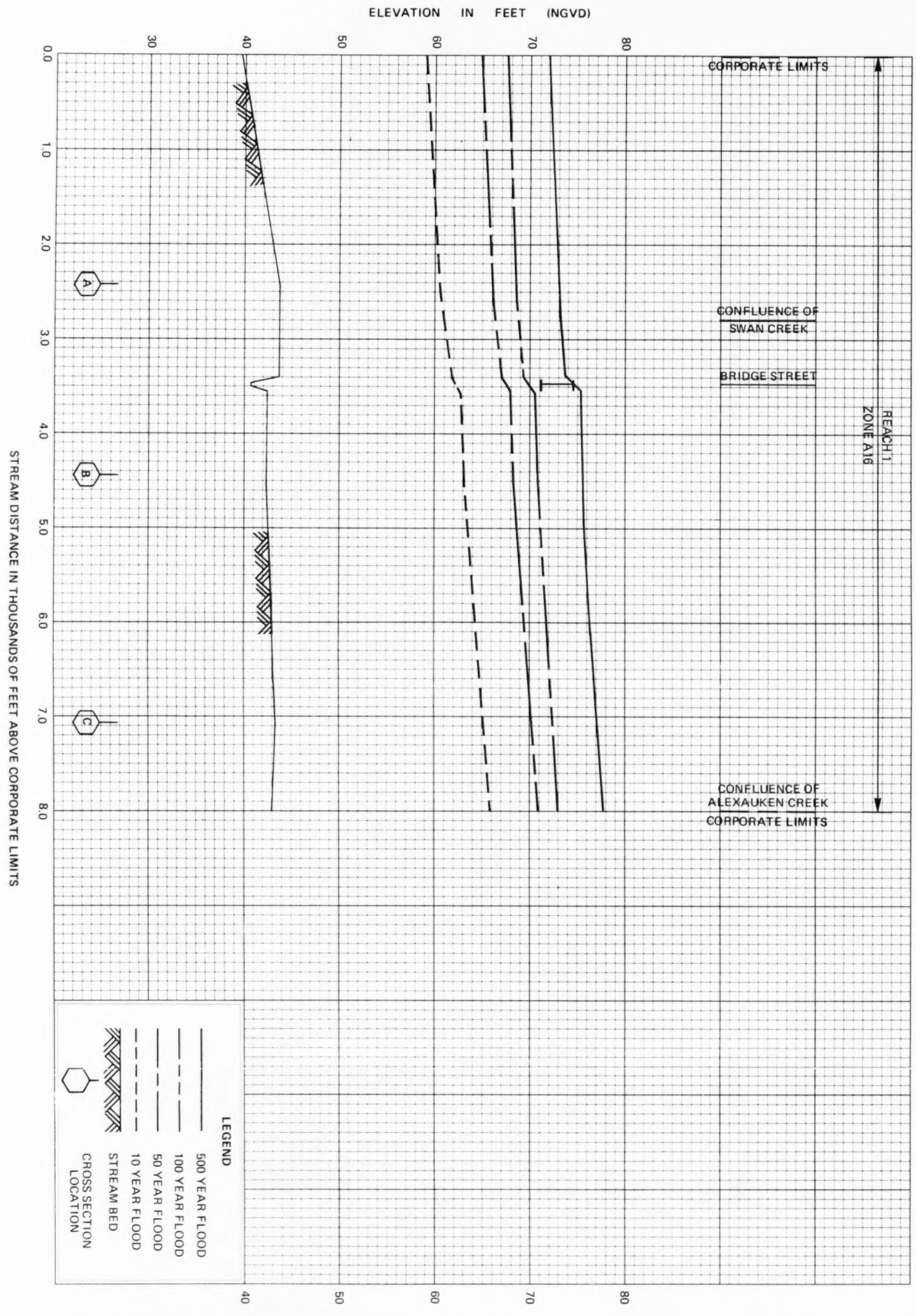
Linsley, Ray K., Max A. Kohler, and Joseph L. H. Paulhus, Hydrology for Engineers, New York, McGraw-Hill, 1958.

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Application of the HEC-2 Bridge Routines, Training Document No. 6, Davis, California, June 1974.

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Floodway Determination Using Computer Program HEC-2, Training Document No. 5, Davis, California, May 1974.

U. S. Department of the Interior, Geological Survey, Water-Supply Paper 1849, Roughness Characteristics of Natural Channels by Harry H. Barnes, Jr., Washington, D. C., 1967.

Water Resources Council, "A Uniform Technique for Determining Flood Flow Frequency," Bulletin 15, Washington, D. C., December 1967.



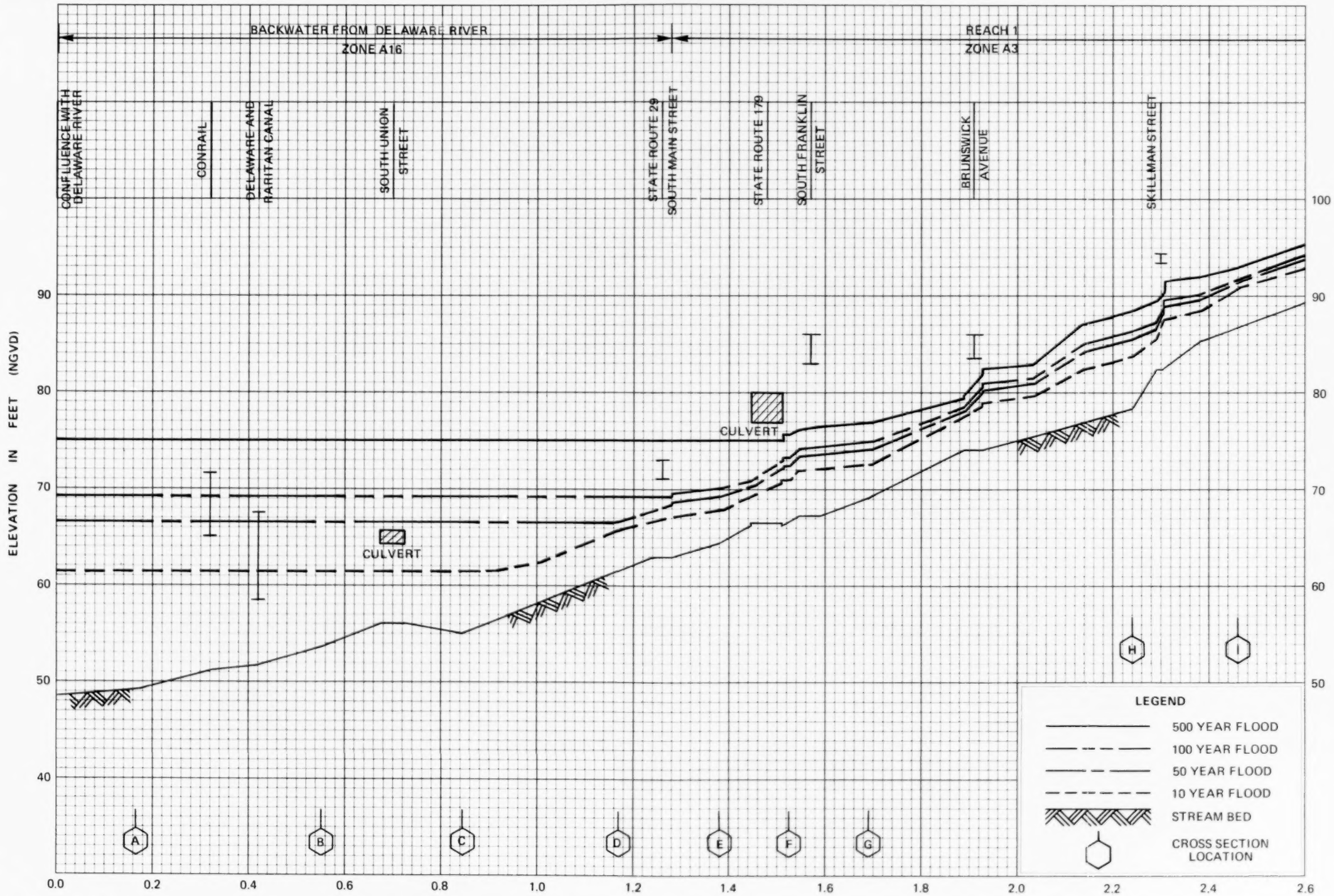

01P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF LAMBERTVILLE, NJ**
(HUNTERDON CO.)

**FLOOD PROFILES**

**DELAWARE RIVER**



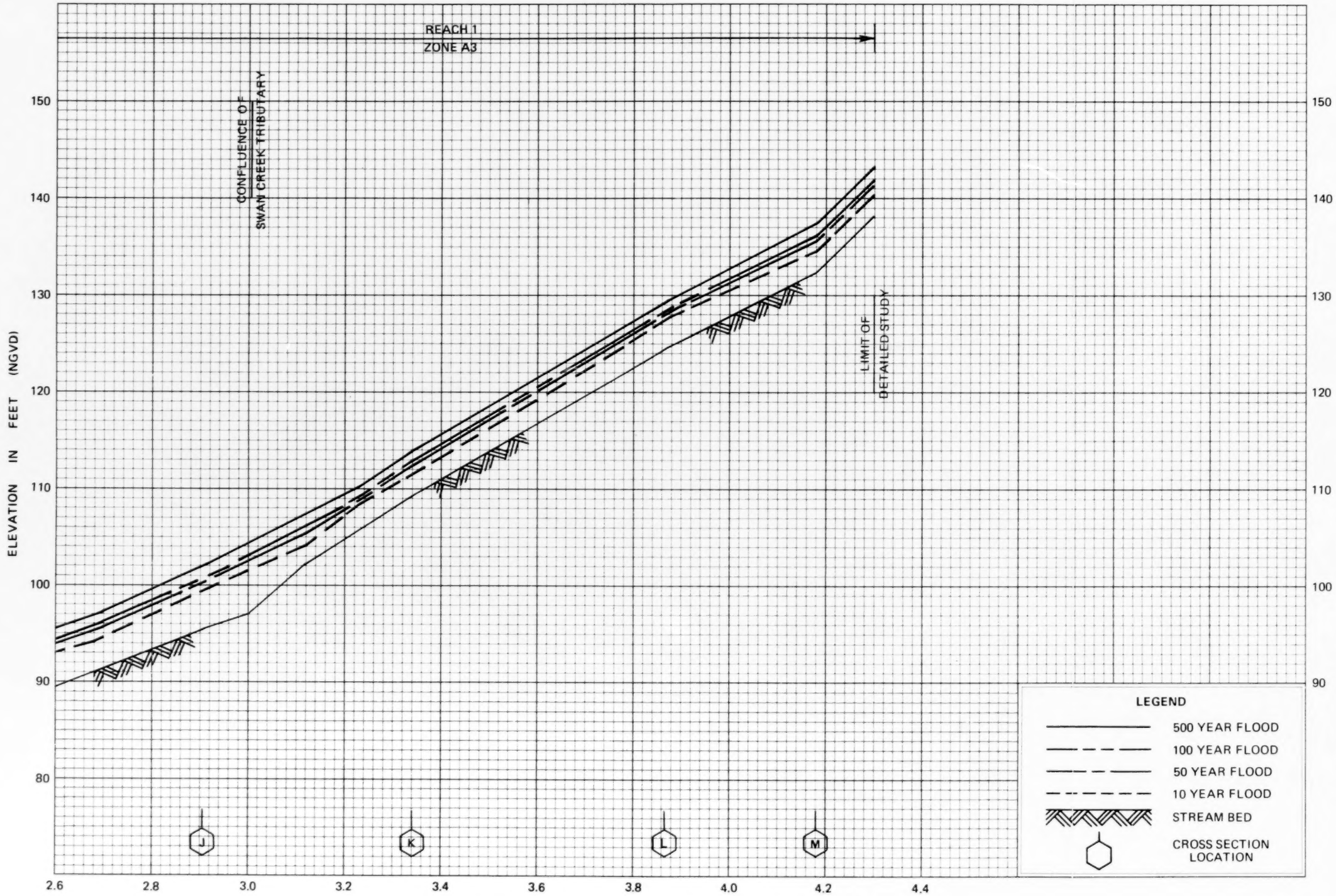

# FLOOD PROFILES

## SWAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

## CITY OF LAMBERTVILLE, NJ
(HUNTERDON CO.)

02P



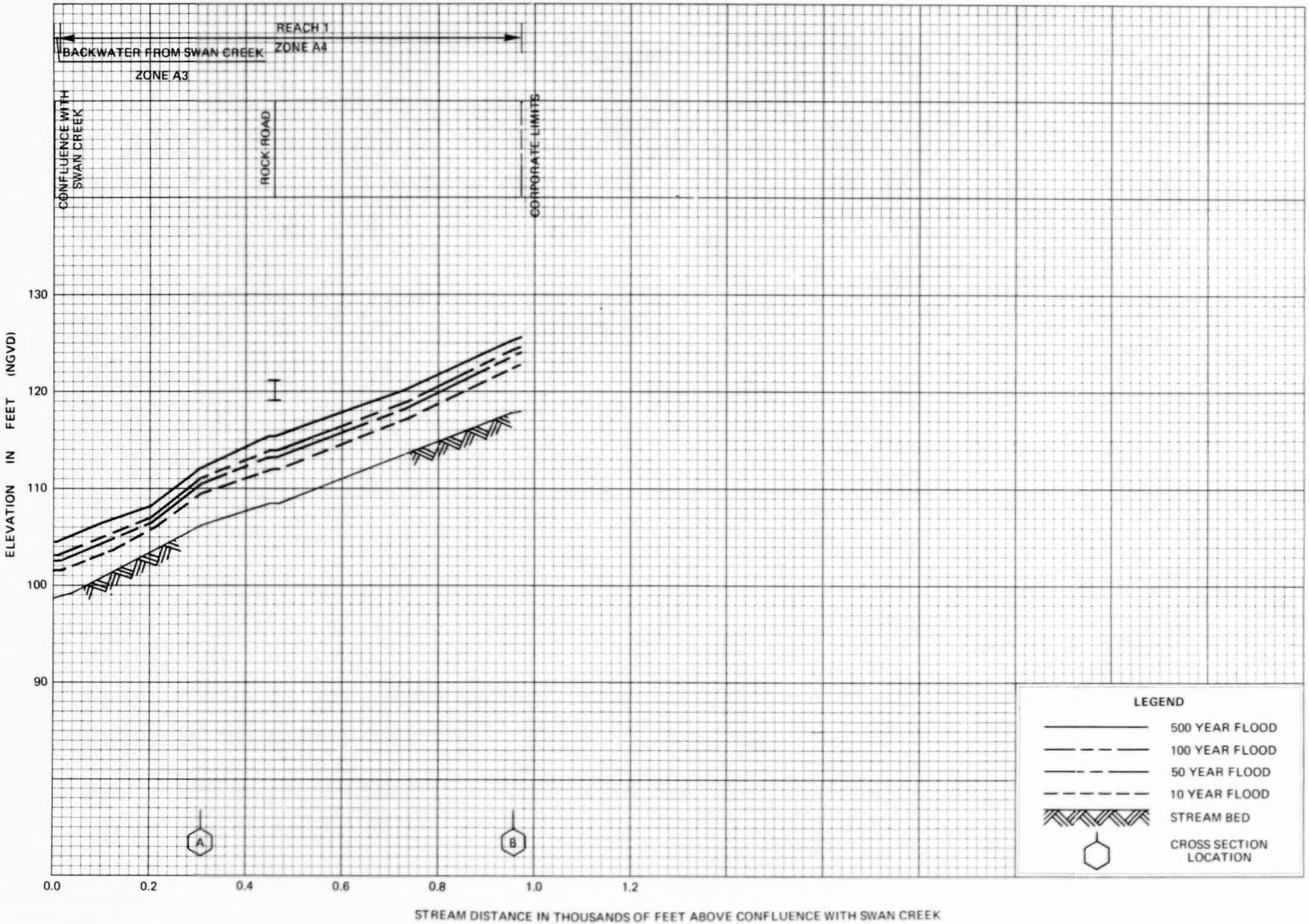

FLOOD PROFILES

SWAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF LAMBERTVILLE, NJ
(HUNTERDON CO.)

03P



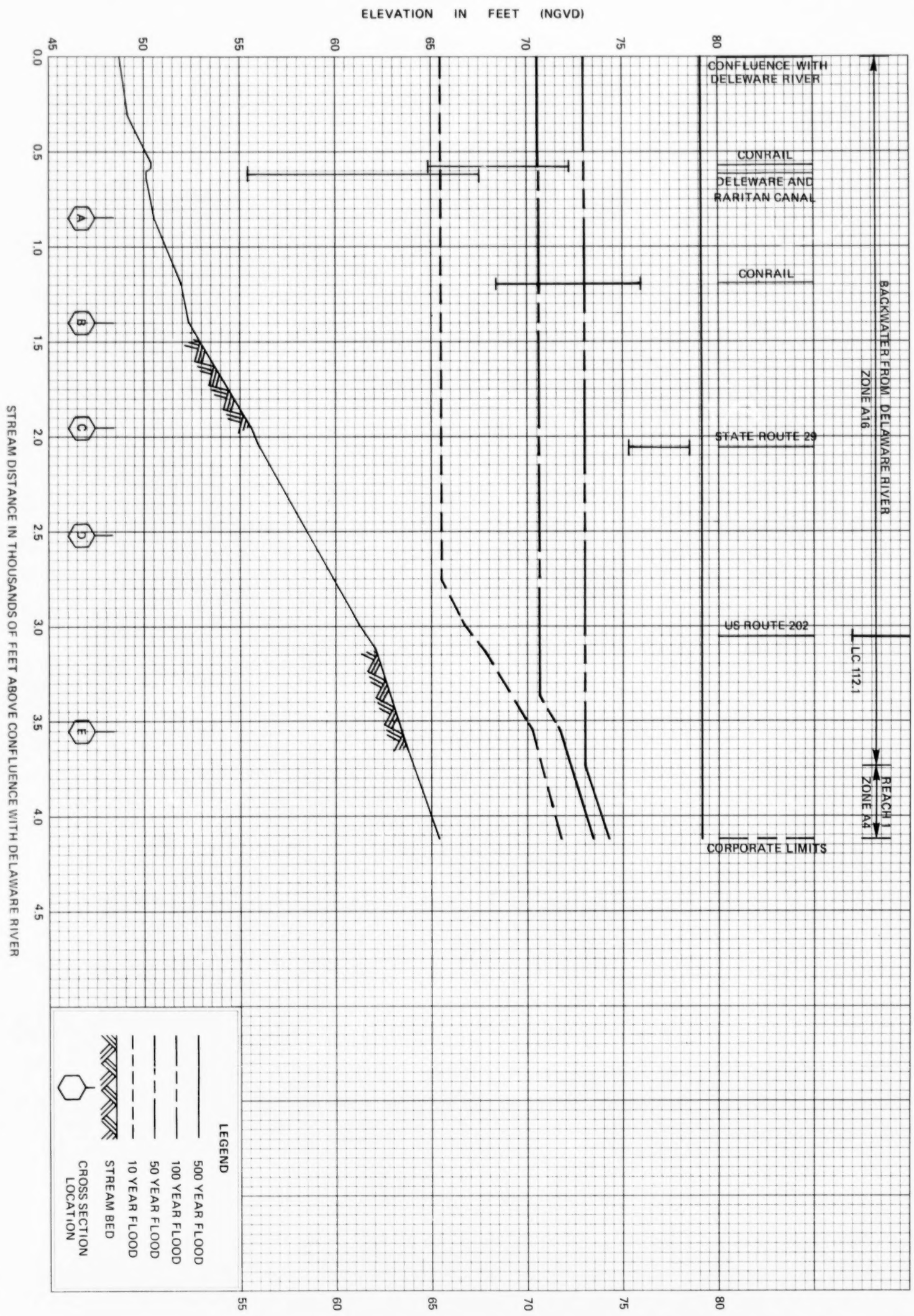

FLOOD PROFILES

SWAN CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF LAMBERTVILLE, NJ
(HUNTERDON CO.)

04P




05P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF LAMBERTVILLE, NJ**
(HUNTERDON CO.)

**FLOOD PROFILES**

**ALEXAUKEN CREEK**